GA1.13:NSIAD-90-107

GAO D546.D 565

United States General Accounting Office
Report to the Secretary of Defense

COMPLETED 20

WEAPONS TESTING

DOD Needs to Plan and Conduct More Timely Operational Test Evaluation

JUN 16 1990

GAO

United States
General Accounting Office
Washington, D.C. 20548

National Security and
International Affairs Division

B-222886

May 17, 1990

The Honorable Richard B. Cheney
The Secretary of Defense

Dear Mr. Secretary:

The Congress continues to express concern that weapon systems have begun production without operational test and evaluation (OT&E). OT&E conducted before a system's "production start-up,"[1] is a key internal control to ensure that decisionmakers have the best information available on a weapon system's performance to minimize risks of procuring costly and ineffective systems.

We identified many perceived barriers to earlier OT&E. Several had been previously reported by us and other agencies, and others were identified during discussions with officials in the Office of the Secretary of Defense (OSD) and the military services. This report provides the results of our analysis of the feasibility of overcoming three major barriers that we believe will allow OT&E before production start-up. The three barriers were

- lack of prototypes for testing early,
- starting production before development is completed (concurrency), and
- the need to start production to obtain OT&E test articles.[2]

We recognize that other factors, such as cost, urgency, and the state of advanced technology may sometimes preclude OT&E before production start-up. However, making OT&E results available before production start-up could help preclude cost growth, schedule slippages, and performance shortfalls that frequently arise during the later phases of a weapon system's development.

Several events make the present systems acquisition environment very receptive to earlier OT&E. These include (1) recent DOD reports that espouse the "aggressive use of prototyping and testing to identify and remedy problems before production," (2) DOD's revisions to acquisition and test and evaluation regulations currently underway, (3) the

[1]In this report, we use the term production start-up to refer to that point in the acquisition process at which a weapon system or its subsystems begin production. "Low-rate initial production [LRIP]," "limited production," and "pilot production" are terms that the Department of Defense (DOD) uses to refer to production start-up.

[2]Test articles are the units of a weapon system that are used to test a weapon's performance.

appointment of a new Director of OT&E, (4) the need to make critical trade-off decisions in systems' acquisition, and (5) DOD's agreement, in response to our May 1989 report discussed on page 4, to reemphasize the need for OT&E as early as possible in the acquisition cycle.

Results in Brief

Several DOD and congressional initiatives to reduce risks in system acquisition and many reports have highlighted weapon system performance and testing shortfalls. Our review of six current systems plus other recent work shows that DOD has made little progress in assuring that earlier OT&E is planned and conducted. The military services generally are not conducting or planning to conduct OT&E on weapon systems until after production start-up.

In our view, the barriers we examined do not preclude earlier OT&E. With proper planning, an operational test can and should be accomplished before production start-up.[3] We found that although some prototypes have been used for development test and evaluation, the military services generally are not planning to use them for OT&E before production start-up. We believe, however, that with adequate planning, prototypes can be designated for OT&E. We also found that concurrency does not preclude earlier OT&E, if such testing is properly planned. Moreover, because test articles are available during the full-scale development phase of the acquisition process, it is generally not necessary to begin production to provide them for OT&E.

Background

DOD budgets over $100 billion annually for research, development, test, and evaluation and for production of major weapon systems. In view of such large sums, decisionmakers need the best information possible on weapon systems' operational performance and risks associated with new technology before approving production start-up. OT&E is intended to provide an independent analysis of a weapon system's performance against operational requirements and the system's reliability and ability to be supported in the field.

[3]OT&E before production start-up may be in addition to later OT&E conducted to support a full-rate production decision (often referred to as the "final exam"). OT&E before production start-up (1) may be on a system or critical subsystem prototype, (2) might not meet all requirements for effectiveness or suitability, and (3) should not be viewed as a "pass/fail" test but can serve as an input to the design process to ensure problems are addressed before a system begins production.

The services are statutorily required to conduct OT&E before making a full-rate production decision. DOD's current test and evaluation policy[4] not only reflects this, but also states that "OT&E shall be structured to provide inputs at each decision point, including major milestones."[5] Yet, DOD's policy also permits production start-up before OT&E is conducted.

Studies of the DOD acquisition process have recommended earlier operational testing, using prototypes, before production start-up. In 1986, the President's Blue Ribbon Commission on Defense Management (the Packard Commission) recommended that operational testing of prototype systems begin early in advanced development and continue through full-scale development. DOD's recent Defense Management Review initiatives, as reflected in the July 1989 DOD Report to the President on Defense Management and the January 1990 DOD Annual Report to the President and the Congress, support implementation of the Packard Commission recommendations, including aggressive use of prototyping and testing to identify and remedy problems "well prior to commencement of high rate production."

With Proper Planning, OT&E Before Production Start-Up Is Feasible

Over the years, we have reported on weapon system performance shortcomings and the lack of adequate OT&E. (See app. III.) Our work on six current systems plus our other recent work (see apps. I and II) has shown that OT&E is not being conducted until production start-up has been approved. We understand that the military services want to move weapon systems into production as quickly as possible in order to reduce the likelihood of them being canceled—a "build now and fix problems later" attitude.

We believe that OT&E results have not been available to support decisions to start production because of the failure of the military services to plan for earlier OT&E and incorporate it into program acquisition strategies. The barriers often cited for OT&E not being adequately planned for or conducted before production start-up has been approved include (1) prototypes not available for testing early, (2) concurrency, and (3) the need to start production to obtain OT&E test articles. We believe that these barriers do not preclude OT&E prior to production start-up.

[4]In DOD Directive 5000.3, Test and Evaluation, dated March 12, 1986.

[5]The milestones are: I (to start the concept demonstration/ validation phase), II (to enter the full-scale development phase), and III (to enter the production phase).

In a recent report on test and evaluation,[6] we discussed the manner in which DOD used early operational assessments. Early operational assessments provide input to decisionmakers on whether a weapon system is ready for the "final exam OT&E" and whether operational shortfalls are being identified and corrected early in the development process. These assessments, which usually rely on development test data, are being used to support decisions for full-scale development and production start-up. We reported in May 1989 that DOD's reliance on early operational assessments when equipment is unavailable for OT&E is a step forward in filling the information void, but should not be a substitute for OT&E. However, we support DOD's current policy that calls for OT&E at each decision point, including major milestones, and believe that more emphasis should be given to conducting OT&E before production start-up. This OT&E should not be viewed as a pass/fail test; it would function as an input to decisionmakers to ensure that problems are identified before a system begins production.

Prototypes Are Being Built but Not Being Used for OT&E

Our review has shown that even though prototypes have been built or are under construction for some systems, the services generally do not plan to use them to conduct OT&E. For example, prototypes were built or under construction for five of the six systems we reviewed (the Air Force's Advanced Tactical Fighter and Short Range Attack Missile-II, the Army's Non-Line-Of-Sight Missile, and the Navy's Long-Range Air Anti-Submarine Warfare Capability Aircraft and Fixed Distributed System). However, only the Navy used or has plans to use its prototypes in OT&E before production start-up. This is because only the Navy has regulations calling for OT&E before production start-up. The other services' regulations only require OT&E to support full-rate production decisions, although some field testing or experimentation may be conducted.

The Navy used the Fixed Distributed System prototype to conduct OT&E before production start-up. Although the Fixed Distributed System was not a mature system with a prototype available for only one of its two major subsystems, the Navy considered the OT&E results to be useful. This OT&E was conducted before full-scale development.

We recognize that not all systems can or should have prototypes. However, OT&E conducted before the decision to begin production could be performed on critical subsystems if it is not feasible to have a prototype

[6]Navy Weapons Testing: Defense Policy on Early Operational Testing (GAO/NSIAD-89-98, May 8, 1989).

of the full system. The controlling factors would be system/subsystem maturity and the expected risk.

For earlier OT&E to be conducted, acquisition strategy from the beginning should require that prototypes be built and operationally tested before the decision to begin production is made. This is the responsibility of acquisition managers, not operational testers.

Concurrency Does Not Preclude OT&E Before Production

As we have previously reported,[7] concurrency can be an effective technique for expediting acquisitions if it is well planned and controlled; however, the practice increases the risk that systems will be produced with major flaws. OT&E before production start-up is an especially important safeguard against the increased risks of concurrent programs.

On April 17, 1990, DOD reported to the Congress that its policy allows varying degrees of concurrency, but mandates the completion of testing and the assessments of results before the production phase.[8] Proposed concurrency guidelines call for the aggressive use of prototypes and testing to identify problems well before production. Under normal circumstances, the low-rate initial production decision should be supported by the completion of some early OT&E.

Most DOD officials we talked with concerning earlier OT&E believe that it is feasible to conduct OT&E before most production start-up decisions. However, our discussions identified several factors that need to be considered when OT&E is to be conducted before the production start-up decision:

- OT&E must be planned as part of the system's acquisition strategy.
- Systems tested early may not meet all requirements for suitability (i.e., reliability, availability, and maintainability).
- Decisionmakers need to be told that OT&E earlier in the acquisition process should not be viewed as pass/fail; it should be viewed as a way to identify system performance shortfalls that need to be corrected before production begins.

[7] Production of Some Major Weapon Systems Began With Only Limited Operational Test and Evaluation Results (GAO/NSIAD-85-68, June 19, 1985).

[8] As requested by section 801 of the National Defense Authorization Act for Fiscal Years 1990 and 1991, DOD was to report on the risk associated with concurrency in major acquisition programs.

We believe that these factors are also important to systems that are not categorized as concurrent programs.

Production Start-Up Is Generally Not Necessary for OT&E Test Articles

Production start-up is traditionally considered as a means by which test articles are acquired for OT&E. The military services usually use the term low-rate initial production to describe this. However, the Congress and DOD's Inspector General have expressed concern that the services' use of low-rate initial production has sometimes resulted in de facto full-rate production before any OT&E is conducted. To try to control the misuse of low-rate initial production, in November 1989, the Congress passed legislation requiring an appropriate DOD official to specify the quantities of test articles needed for OT&E in major programs to decrease the number of items produced before OT&E was conducted.

We found that production start-up is generally not necessary to produce OT&E test articles. The DOD budget manual and the military services' regulations require or at least allow OT&E test articles to come out of full-scale development. In addition, we identified many systems currently under development or in production where the services plan to use or have used OT&E test articles produced from full-scale development. (See app. I.) In only one of the six systems we reviewed will the OT&E test articles come from a low-rate initial production decision. In that case, according to the Deputy Program Manager, the Line-of Sight-Forward-Heavy was already in production for an allied country before the U.S. Army bought it.

Conclusions and Recommendations

Weapon systems are starting production before OT&E is conducted because DOD is not giving full effect to its policy for OT&E at each decision point, including major milestones. On numerous occasions we have reported the negative effects of systems that have been produced without adequate OT&E. The barriers to earlier OT&E can be overcome with better planning.

To strengthen DOD's recent reaffirmation of the proper role of OT&E as a key internal control in the systems acquisition process made through the Defense Management Review initiatives, we recommend you ensure that DOD acquisition and testing directives currently under revision

- clearly establish the need for OT&E before production start-up;

- define when OT&E must occur and when it may be appropriate for decisionmakers to rely on operational assessments in lieu of OT&E for production start-up decisions, as previously recommended in our May 1989 report;
- require the services to plan for and conduct earlier OT&E; and
- ensure that acquisition strategies for major weapon systems require system or subsystem prototypes be built where practical and that these prototypes be operationally tested before production start-up.

Scope and Methodology

To determine whether perceived barriers precluded early OT&E, we performed work at test and program oversight offices within OSD, military service headquarters, and operational test agencies, and applicable program executive and management offices. On the basis of a judgment sample drawn with direct OSD and service input, we examined six current systems and reviewed our prior and recently reported work on additional systems. (See apps. I, II, and III.) We also performed an extensive literature search and review of available documents on defense acquisition, testing, prototyping, and concurrency.

We did not obtain written agency comments on this report. However, we discussed the information in this report with DOD officials and incorporated their comments as appropriate. DOD officials were very receptive to our findings and conclusions and believed that systems acquisition changes would be helpful to the OT&E community. They pointed out that Defense Management Review initiatives and the Under Secretary of Defense for Acquisition are stressing the need for earlier OT&E.

We conducted our work from August 1989 through February 1990 in accordance with generally accepted government auditing standards.

As you know, 31 U.S.C. 720 requires the head of a federal agency to submit a written statement on actions taken on our recommendations to the House Committee on Government Operations and the Senate Committee on Governmental Affairs not later than 60 days after the date of the report. A written statement must also be submitted to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report.

We are sending copies of this report to the Chairmen, House Committees on Government Operations and on Armed Services and Senate Committees on Governmental Affairs and on Armed Services, the Secretaries of

the Army, Air Force, and Navy; the Director, OT&E; the Deputy Director for Defense Research and Engineering/Test and Evaluation; the Director, Office of Management and Budget; and the military service operational test agencies. We will also make copies available to other interested parties upon request.

This report was prepared under the direction of Mr. Paul F. Math, Director, Research, Development, Acquisition, and Procurement Issues, who may be reached on (202) 275-8400 if you or your staff have questions concerning the report. Major contributors to this report are listed in appendix IV.

Sincerely yours,

Frank C. Conahan
Assistant Comptroller General

BLANK PAGE

Contents

Letter	1
Appendix I OT&E Schedules for Six Weapon Systems We Reviewed	12
Appendix II Examples of Systems Noted in Our Recent Reports That Did Not Have OT&E Planned Before Production Start-Up	13
Appendix III Examples of Reports Illustrating Where Production Decisions Were Made Before OT&E Was Started or Completed	15
Appendix IV Major Contributors to This Report	18

Abbreviations

DOD	Department of Defense
OSD	Office of the Secretary of Defense
OT&E	operational test and evaluation
RWR	radar warning receivers

BLANK PAGE

OT&E Schedules for Six Weapon Systems We Reviewed

Service/system	Fiscal years: Program start	Planned OT&E	Initial production decision	Source of OT&E test articles[a]
Army				
Line-of Sight-Forward-Heavy (Air Defense Anti-Tank System)	1987	1990	1987[b]	Low-rate initial production
Non-Line-of-Sight[c] (Fiber Optic Guided Missile)	1987	1994	1991[b]	Full-scale development
Air Force				
Advanced Tactical Fighter[c]	1981	1997	1994[b]	Full-scale development
Short-Range Attack Missile-II[c]	1985	1992	1991[b]	Full-scale development
Navy				
Long-Range Anti-Submarine Warfare Advanced Capability Aircraft[c] (P-7A)	1986	1992	1992[b]	Full-scale development
Fixed Distributed System[c]	1984	1988[d]	1989[b]	Demonstration/validation

[a]Without extensively reviewing additional systems, we noted that several others used full-scale development items for producing OT&E test articles. These were MK-48 Advanced Capability Torpedo, Extremely Low Frequency Communication System, AN-SQS-53C Long-Range Sonar, and Airborne Self-Protection Jammer.

[b]For low-rate initial production.

[c]Prototypes have been built or planned for these systems. However, the services are not planning to use the Non-Line-of-Sight Missile, Short-Range Attack Missile-II, and Advanced Tactical Fighter prototypes for OT&E.

[d]An OT&E, such as the one described in footnote 3 on page 2, was successfully conducted.

Examples of Systems Noted in Our Recent Reports That Did Not Have OT&E Planned Before Production Start-Up

Abrams Tank: Block II Modifications Not Ready for Production (NSIAD-90-57, Feb. 28, 1990)

- Army will commit $166.4 million to the M1A2 tank program before development prototype testing is begun.
- OSD had not approved the Army's test and evaluation master plan as of August 1989 because it was concerned that the Army had not sufficiently planned live-fire testing and OT&E, which needs to be completed and evaluated before the production decision is made in August 1991.

Strategic Bombers: B-2 Program Status and Current Issues (NSIAD-90-120, Feb. 22, 1990)

- B-2 aircraft acquisition strategy includes ordering a large number of planes before the necessary testing to demonstrate that the B-2 can perform its mission is completed.

ICBM Modernization: Rail Garrison Production Decision and Launch Car Acquisition Should Be Delayed (NSIAD 90-19, Dec. 7, 1989)

- No OT&E of the complete weapon system (missiles and rail cars) will have been conducted prior to the initial production decision.
- We recommended that the Secretary of Defense delay the April 1990 initial Rail Garrison production decision until the Air Force has conducted some OT&E of the complete system.

Navy Weapons Testing: Defense Policy on Early Operational Testing (NSIAD 89-98, May 8, 1989)

The following seven programs were authorized for low-rate initial production with no OT&E:

- ALQ-165 Airborne Self-Protection Jammer.
- SQS-53C Sonar.
- E-6A Aircraft.
- MK-45 Capsule Launching System.
- Ocean Surveillance Information System Baseline Upgrade.
- TB-23 Accelerated Thinline Towed Array.
- AN/BSY-2 Submarine Combat System.

Navy/Air Force Still Developing Separate, Costly Radar Warning Receivers (NSIAD-87-167, July 1, 1987)

- Five radar warning receivers (RWR) started production before OT&E was completed.
- Starting production before adequately testing the systems has resulted in the purchase of equipment that cannot be used for its intended purpose, production of RWR that were placed in storage rather than installed, and deployment of RWR judged operationally unsuitable to U.S. combat forces by testing officials.

Examples of Reports Illustrating Where Production Decisions Were Made Before OT&E Was Started or Completed

Operational Test and Evaluation Can Contribute More to Decisionmaking (NSIAD-87-57, Dec. 23, 1986)

Our analysis showed 41 cases where production was approved before OT&E was started or completed. Thirty-one of the 41 cases were identified in our reports and summarized in this December 23, 1986, report. The 31 reports are listed below.

1. Adverse Effects of Large-Scale Production of Major Weapons Before Completion of Development and Testing (B-163058, Nov. 19, 1970)

2. The Importance of Testing and Evaluation in the Acquisition Process for Major Weapon Systems (B-163058, Aug. 7, 1972)

3. Review of the Adequacy of Department of Defense Test Resources (PSAD-75-84, Apr. 30, 1975)

4. Effectiveness of Testing of Selected Major Weapon Systems (PSAD-75-74, June 4, 1975)

5. Need for Additional Test and Evaluation on the Major Caliber Lightweight Gun (PSAD-77-4, Nov. 5, 1976)

6. Navy Operational Test and Evaluation - A Valuable Tool Not Fully Utilized (PSAD-78-77, Mar. 29, 1978)

7. Operational Testing of Air Force Systems Requires Several Improvements (PSAD-78-102, June 2, 1978)

8. Department of Defense's Conduct of Operational Test and Evaluation of Foreign Built Weapon Systems (PSAD-79-131, July 25, 1978)

9. Practices and Procedures for Follow-On Operational Testing and Evaluation of Weapon Systems by the Military Services (PSAD-79-1, Oct. 19, 1978)

10. Army Operational Test and Evaluation Needs Improvements (PSAD-80-2, Nov. 13, 1979)

11. M1 Tank's Reliability is Still Uncertain (PSAD-80-20, Jan. 29, 1980)

12. F/A-18 Naval Strike Fighter: Its Effectiveness Is Uncertain (PSAD-80-24, Feb. 14, 1980)

13. Cruise Missiles: Status and Issues as They Near Production (PSAD-80-19, Feb. 28, 1980)

14. Future Procurements of Army's Copperhead Projectile Should Be Contingent on Improvements in Performance and Reliability (PSAD-81-4, Nov. 13, 1980)

15. Review of the High Speed Anti-Radiation Missile Program (MASAD-81-7, Feb. 28, 1981)

16. Some Land Attack Cruise Missiles Acquisition Programs Need to Be Slowed Down (MASAD-81-9, Feb. 28, 1981)

17. Most Critical Testing Still Lies Ahead for Missiles in Theater Nuclear Modernization (MASAD-81-15, Mar. 2, 1981)

18. The Army's Advance Attack Helicopter Is Not Ready for Production (MASAD-82-8, Dec. 1, 1981)

19. Air Launched Cruise Missile Shows Promise but Problems Could Result in Operational Limitations (C-MASAD-82-13, Feb. 26, 1982)

20. Progress of the Light Armored Vehicle Program Should Be Closely Monitored (MASAD-82-41, Aug. 10, 1982)

21. Results of Production Testing Should Be Considered Before Increasing Patriot's Production (MASAD-83-7, Jan. 26, 1983)

22. Acquisition of the Over-The-Horizon Backscatter Radar System Should Be Reevaluated (MASAD-83-14, Mar. 15, 1983)

23. The B-1 Bomber Program - A New Start (MASAD-83-21, Apr. 13, 1983)

24. Better Planning and Management of Threat Simulators and Aerial Targets Is Crucial to Effective Weapon Systems Performance (MASAD-83-27, June 23, 1983)

25. Air Force and Navy Trainer Aircraft Acquisition Programs (MASAD-83-22, July 5, 1983)

26. Results of Forthcoming Critical Tests Are Needed to Confirm Army Remotely Piloted Vehicle's Readiness for Production (NSIAD-84-72, Apr. 4, 1984)

27. Status of the Peacekeeper (MX) Weapon System (NSIAD-84-112, May 9, 1984)

28. Army's Decision to Begin Production of the High Mobility Multipurpose Wheeled Vehicle Was Premature (NSIAD-84-136, June 12, 1984)

29. Army Has the Opportunity to Recompete DAS3 Purchases and Improve Automated Battlefield Support (IMTEC-84-20, Sept. 28, 1984)

30. Production of Some Major Weapon Systems Began With Only Limited Operational Test and Evaluation Results (NSIAD-85-68, June 19, 1985)

31. Evaluation of Army's Mobile Subscriber Equipment Program (NSIAD-85-117, July 16, 1985)

Major Contributors to This Report

National Security and International Affairs Division, Washington, D.C.	Michael E. Motley, Associate Director Lester C. Farrington, Assistant Director Maureen Machisak-Herndon, Evaluator
Norfolk Regional Office	Fred Harrison, Regional Management Representative Leslie Gregor, Evaluator-in-Charge Clifton Spruill, Site Senior Julie Chapman, Evaluator Jim Marshall, Advisor
Denver Regional Office	Ted Baird, Regional Management Representative Ernest Beran, Regional Assignment Manager

Requests for copies of GAO reports should be sent to:

U.S. General Accounting Office
Post Office Box 6015
Gaithersburg, Maryland 20877

Telephone 202-275-6241

The first five copies of each report are free. Additional copies are $2.00 each.

There is a 25% discount on orders for 100 or more copies mailed to a single address.

Orders must be prepaid by cash or by check or money order made out to the Superintendent of Documents.